

so-called waterspout consists in the rapid shooting down from a dense cloud of a black cloudy streak, seemingly tortuously revolving and swaying more or less sidewise. This is said rapidly to prolong itself downwards till it meets the surface of the sea; and the water of the sea is often imagined and described as rising up bodily, or as being drawn up, into the partial vacuum or central columnar place of diminished pressure. The frequently entertained notion—a notion which has even made its way into writings by men of science and of authority in meteorology—that the water of the sea is sucked up as a continuous liquid column in the centre of waterspout whirlwinds, is by some writers and thinkers repudiated as being only a popular fallacy, and it is affirmed that it is only the spray from the broken waves that is carried up. In this denial of the supposition of the water being sucked up as a continuous liquid column the author entirely agrees, and he agrees in the opinion that spray or spindrift from the sea set into violent commotion by the whirlwind is carried up in a central ascending columnar core of air.

On the other hand, the commonly-alleged inception of the visible waterspout phenomena, in a descending, tortuously-revolving, and laterally-bending or swaying cloudy spindle protruding from a cloud, the author supposes to be so well accredited by numerous testimonies that it must be seriously taken into account in the development of any true theory and explanation of the physical conditions and actions involved. He ventures to hazard a suggestion at present—perhaps a very crude and rash one. It is that the rising central core may perhaps, in virtue of its whirling motion and centrifugal tendency, afford admission for the cloudy stratum to penetrate down as an inner core within that revolving ascending core now itself become tubular. The cloudy stratum may be supposed not originally to have been endowed with the revolutionary motion or differential horizontal motion with which the lower stratum of thermally expanded air has been assumed to be originally endowed. The upper stratum of air from which the cloudy spindle core is here taken to protrude down into the tubular funnel is not to be supposed to be cold enough to tend to sink by mere gravity. Though it were warm enough to allow of its floating freely on the thermally expanded air below, it could still be sucked down into the centre of the revolving ascending core of the whirlwind.

Not to proceed further on this occasion with attempts towards explanation of the difficult subject of the actions at the upper ends of waterspout whirlwinds, the author wishes to have it understood that his main object in proceeding to prepare the present paper was to put forward clearly the theory he has given as to influx at the bottom in consequence of abatement of whirl in the lamina close to the sea-surface by frictional resistance there.

Addendum.—A few brief explanations and references will now be added to assist in the understanding of some of the principles assumed in what has been already said. It is to be clearly understood that, in a whirling fluid, even if the velocity of the whirling motion be very small at great distances from the axis, if the fluid be impelled inwards by forces directed towards the axis, the absolute velocity will greatly increase with diminution of distance from the axis. Thus in the *whirlpool of free mobility*, in which the particles are perfectly free to move outward or inward, the velocities of the particles are inversely proportional to the distances from the axis, the fluid being understood to be inviscid or frictionless. On this subject reference may be made to a paper by the author on "Whirling Fluids," published in the British Association volume for the Belfast Meeting, 1852. Again, as to the inward flow caused in a frictionally retarded bottom lamina of a whirlwind or whirlpool with vertical axis, by the frictional retardation from the bottom on which the whirling fluid rests, reference may be made to a paper by the author, "On the Grand Currents of Atmospheric Circulation" in the British Association Report, Dublin Meeting, 1857, part ii. p. 38. On another case of the manifestation of the same principle, reference may be made to a paper by the author in the *Proceedings of the Royal Society* for May 1876, in respect to the "Flow of Water round Bends in Rivers, &c.," with reference to the effects of frictional resistance from the channel in the bends; and to another paper by him, on the same subject, in the *Proceedings of the Institution of Mechanical Engineers* (August 1879, p. 456), where the inward flow is explained as experimentally exhibited.

Postscript of date August 16.—Prof. James Thomson wishes now to offer in continuation of his paper on "Whirlwinds and Waterspouts," despatched two days ago for Montreal the follow-

ing postscript, which will extend the considerations there already put forward, and will tend to modify or amend some of them; but will leave unchanged the theory as to influx of the bottom lamina of the whirlwind towards the central region in consequence of the frictional resistance offered by the surface of the sea to the air whirling in close contiguity upon that surface.

He wishes to put forward the question as to whether it may not be possible, in some cases of whirlwinds, for the barometric pressure in the central or axial region to become abated through the combined influences of rarefaction by heat (increased, perhaps, by conditions as to included moisture) on the one hand, and the whirling motion on the other hand, very much beyond the abatement that could be due to heat, or heat and moisture, alone, without the whirling motion. He thinks it very likely that in great whirlwinds, including those which produce the remarkable phenomena called waterspouts, it may be impossible for the whirling action to be confined to the lower region of the atmosphere; but that, even if commenced there, it would speedily be propagated to the top. It seems also not unlikely, and in some trains of thought it comes to appear very probable, that the whirling fluid, ascending by its levity, would drive outwards from above it all other air endowed with less whirling energy, and would be continually clearing away upwards and outwards the less energetic axial core which enters from below, and any, if such there be, that has entered from above. He is unable at present to offer much in further elucidation (possibly it might only prove to be in further involvement) of this very difficult subject. He thinks the question should at least be kept open as to whether the whirling and scouring action may not go forward growing more and more intense, promoted always by energies from the thermal sources which have produced differences of temperature and moisture in different parts of the atmosphere, and that thus a much nearer approach to vacuum in the centre may be caused than would be due merely to the levity of the superincumbent air if not whirling.

He also wishes to suggest that the dark and often frightful cloud usually seen in the early stages of whirlwinds and waterspouts, and the dark columnar revolving core often seen apparently protruding downwards from the cloud, may be due to precipitation of moisture into the condition of fog or cloud, on account of abatement of pressure by ascension in level, and environment with whirling air, which by its centrifugal tendency acts in protecting the axial region from the pressure inwards of the surrounding atmosphere.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Dr. Besant and Mr. C. H. Prior are appointed Moderators, and Messrs. C. Graham and A. J. C. Allen Examiners, in the Mathematical Tripos for the year beginning May 1, 1885.

The following Natural Science Examiners have been appointed:—Physics: Prof. A. Schuster and Mr. W. N. Shaw; Chemistry: Messrs. A. Scott and M. Pattison Muir; Mineralogy: Prof. Lewis and Mr. H. P. Gurney; Geology: Messrs. R. D. Roberts and J. J. H. Teall; Botany: Messrs. F. Darwin and H. M. Ward; Zoology: Prof. A. M. Marshall and Mr. A. Sedgwick; Human Anatomy: Prof. A. Macalister and Mr. A. Hill; Physiology: Prof. Michael Foster and Mr. J. N. Langley.

St. John's College offers for competition in December next a large number of Open Scholarships, Exhibitions, and Sizarships. Natural Science is one of the subjects which, taken singly, may lead to election to any of these. The subjects are in general those of the Natural Sciences Tripos; but every candidate in Natural Science must show a competent knowledge of two at least of the following subjects:—Physics, Chemistry, and Biology, all in an elementary sense. A candidate, however, may be elected on the ground of special proficiency in any one of the subjects of examination. There will be both papers and practical work in all subjects. Further information may be obtained from the tutors.

Trinity College Examinations begin on December 11. Major and Minor Scholarships, Exhibitions, and Sizarships may be given for Natural Science. One Exhibition at least, of the value of 50*l.*, will be given for Natural Science to a candidate not yet in residence at the University.

King's College offers an Exhibition of 60*l.* per annum for Natural Science: examination on December 11.

Emmanuel College holds its Entrance Scholarship Examination conjointly with Christ's and Sidney-Sussex Colleges. The subjects in Natural Science are Chemistry, Physics, Elementary Biology, and Geology and Mineralogy. In all branches of Natural Science there is a practical examination. The examinations will begin on January 6 next. A candidate for a Scholarship at one of the above Colleges may be elected to a Scholarship at either of the others in default of better qualified candidates.

Mr. Lea will lecture on Chemical Physiology this term at the New Museums.

Mr. Sedgwick has arranged for a repetition class in Elementary Biology in the Morphological Laboratory, to be superintended by Mr. Weldon.

OWENS COLLEGE, MANCHESTER.—At a recent meeting the Council, on the recommendation of the Senate, made the following appointments to the three vacant Berkeley Fellowships:—In Chemistry, Dr. L. Claisen, formerly First Assistant in Organic Chemistry to Prof. Kekulé of Bonn. In Zoology, Dr. John Beard, of the University of Freiburg, and formerly of Owens College. In Philosophy, Mr. W. E. Johnson, B.A., of King's College, Cambridge. The Berkeley Fellowships are for the encouragement of original research, and the holders are required to reside in Manchester during term time.

SCIENTIFIC SERIALS

Bulletins de la Société d'Anthropologie de Paris, tome vii. fasc. 2, 1884.—This number contains several more than usually interesting communications regarding French palæontological inquiry.—M. D'Acy's paper on the silex of the Chelles Station, which was begun in a previous number, shows that we must regard the Chelles deposits as belonging to two distinct formations: the old Quaternary, or true Chellean, containing remains of *Elephas antiquus* and *Rhinoceros merckii*, and the later Quaternary, or mousterian period, represented as usual by *Elephas primigenius*.—Baron de Baye communicates the discovery in the Neolithic caverns at Petit Morin (Marne) of transversely cut arrow-heads similar to those found in large quantities in Denmark, but hitherto undetected in France. They were intermixed with numerous ordinarily shaped arrow-heads, fragments of Neolithic pottery, and roughly-cut flints, and deposited in a cavity on the summit of a hill, while a vertebral bone (apparently of a badger), which was found in a grotto at a distance of 250 m. from the deposit, still retained a portion of a similarly shaped arrow-head.—M. Gustave Chauvet announced the discovery, in a tumulus on the right bank of the Charente, of a curiously ornamented bronze chariot, similar to those found in Mecklenburg and in Scandinavia. The tumulus, which is situated near Charroux (Vienne), and locally known as "le Gros-Guignon," contained a vaulted recess in which the body had rested, and on either side of which lay wheels with detached ornaments, as circles and spheres, and bronze and iron nails, together with two urns undoubtedly Gallic.—M. Nicaise reported the discovery of another chariot-bier in a tumulus at Septaulx (Marne), on which the body had been laid. In front of the right wheel lay the skeleton of a boar, between whose ribs a long knife was embedded. To this report the writer has added many interesting details in regard to several funeral chariots found in other parts of Marne, more especially in the Gallic cemetery of Varilles, where three skeletons (one adult and two children) had been interred in the same chariot. The weapons, horse-bits, bronze rings, &c., inclosed in these tumuli indicate their Gallic origin.—On the sepulchral grotto of Rousson, near Alais, by M. Charvet. This cave, which was opened in 1883, was found to contain a large number of skulls, mostly dolichocephalic, together with other human bones, and pins and beads of a metal regarded by French palæontologists as copper rather than bronze, and similar to that of various objects found in the Baume des Morts Cavern of Durfort, first explored in 1869, and regarded as belonging to a mixed Celto-Ligurian race.—On a series of explorations at Ploubinec, by M. Gaillard. Four tumuli opened in March 1884 contained cinerary urns, four human skulls, and other bones, flint lance- and arrow-heads, and broken pottery.—A communication by M. Kerckhoffs concerning the lacustrine station lately brought to light near the alluvial beds, in which the notable Maestricht jaw was discovered in 1823. The recent explorations of this interesting site have been conducted by M. Ubaghs, who has found a well-preserved dolichocephalic cranium, together with the bones of *Bos primigenius*, the horse, stag, beaver, dog,

&c., with bone instruments, remains of coarse pottery, &c.—On human sacrifices and anthropophagy among the Vaudous or serpent-worshippers of Haiti, by M. Dehoux.—On the settlements of the Canadian Redskins, and the fluctuation in their numbers, by M. Petitot. The author considers that the solar and demon worship, and the chief social institutions of the Sioux, Hurons, and other North American tribes indicate their affinity with the Dravidian races of India.—The report of a discussion raised by M. Beauregard on the correctness of his views regarding the Dardous, which had been called in question by M. de Ujfalvy.—On the Cachmiris and Pandits, by M. de Ujfalvy. The former he regards as a mixed Mongol and Aryan race, while in the latter he believes we have the representatives of a primitive North-West Indian Aryan type.—On the pretended Eastern origin of the Algonquins, by M. Petitot; and on the diffusion of analogous myths in different lands, by M. Luys.—On dynamometric errors, by Dr. Manouvrier, having special reference to the inexactness of instruments, and the discrepancies between the modes of gradation observed by different instrument-makers.—On the ethnographic researches of M. Quesde in the Antilles, by M. Hamy. The presence of cut flints, although there are no indications of any siliceous rock-formations, points to primitive commercial relations with the mainland.—On the methods of measuring the circumference of the head, by M. le Bon.—A new classification of the pelvis considered from an obstetric point of view, and with special reference to racial distinctions, by Dr. Verrier.—On the traditions and tribal divisions of the Somalis, by M. Bardey. Their legends include one in which Abel is represented as the black and evil brother, while Kahlil is white-skinned and good, while the people profess to derive their descent from two men miraculously saved with their wives from an inundation which engulfed all the inhabitants of the lands near the Mount Taizz, sixty miles east of Mocha, on the summit of which they remained till the waters subsided.

Bull. tin de l'Académie Royale de Belgique, July 5.—Monograph on the central nervous system of adult Ascidians, and its relations to that of the Urodele larvæ (four plates), by MM. Ed. Van Beneden and Ch. Julin.—Note on the calculation of averages; application of a new principle of probabilities, by E. Catalan.—Remarks on the ventral disk of the sea-snail, *Liparis barbatus* (one plate), by Maurice Stuckens.—On the respiration of bats during the period of hibernation, by E. Delsaux.—Anatomy of the cephalic kidney of the larva of *Polygordius*; a contribution to the history of the excreting apparatus of worms, by Julien Fraipont.—On the central and surface nervous systems of the Archannelids (*Protodrilus*, *Polygordius*); a contribution to the history of the origin of the nervous system in these worms, by Julien Fraipont.—On a theorem in mechanics applicable to systems whose movement is periodical, by E. Ronkar.

August 2.—Note on two remarkable experiments in capillary attraction, by G. van der Mensbrugghe.—On the theory of elliptical functions, by P. Mansion.—On the remainder in Taylor's formula, and on the binomial theory, by P. Mansion.—Chemical analysis of a rich phosphate recently discovered in the neighbourhood of Havre near Mons, by C. Blas.—On the conductivity of gaseous bodies for heat, by E. Ronkar.—On the theoretic relations between the coefficients of expansion, the internal heat of vaporisation, and the specific heats of bodies in the liquid and gaseous states, by P. de Heen.—Description of a new apparatus for determining the coefficient of diffusion of salts in solution, and the variations experienced by this quantity according to the temperature, by P. de Heen.—On the generation of certain surfaces by means of quadrilinear groups, by C. Le Page.—Researches on the production of cyanhydric acid in the vegetable kingdom, by A. Jorissen.—Historic note on Stephen Dushan, Emperor of Servia, and the Balkan Peninsula in the fourteenth century, by Emile de Borchgrave.—Discourse pronounced at the obsequies of M. Alexandre Pinchart, by M. Silengencyer.

SOCIETIES AND ACADEMIES

LONDON

Mineralogical Society, October 21.—Anniversary meeting.—The Rev. Prof. Bonney, F.R.S., President, in the chair.—The Hon. Sec., Mr. R. II. Scott, read the Report of the Council.—The scrutineers reported that the following were elected Officers and Council:—President: Rev. Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., F.S.A., Pres.G.S.; Vice-Presidents: Rev. S. Haughton, M.D., F.R.S., W. H. Hudle-